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Experimental assessments of metallic and metal oxide nanoparticles toxicity

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Toxicity of nanoparticles (NPs) of Fe_3O_4 produced by a chemical technique and nanoparticles of Ag, Au, CuO, NiO, Mn_3O_4, PbO, ZnO, TiO_2, SiO_2, Al_2O_3 generated through laser ablation was unvestigated with the help of a single intra-tracheal and repeated intra-peritoneal injections in non-lethal doses. Besides, we carried out long-term inhalation experiments with low concentrations of Fe_2O_3-NP, SiO_2-NP or NiO-NP and *in vitro* experiments on established cell lines with NPs of NiO, Mn_3O_4, PbO, CuO and CdO.

It was proved that these NPs are much more toxic compared to their fine micrometric or even submicron counterparts and are usually the more toxic the smaller their dimensions within the nano-scale range. We found also that toxicity of Me-NPs strongly depends on their chemical nature, solubility and mechanisms of action specific for a particular metal. Solubilization of Me-NPs in biological milieus plays an important role in their toxicokinetic which can prevail over that of the physiological mechanisms controlling their distribution, retention and elimination. On the other hand, thanks to the high activity of these mechanisms, the organism is not defenseless against the impact of Me-NPs.

The nonspecific responses of the organism to the impact of Me-NP included: changes in the cytological and some biochemical characteristics of the bronchoalveolar lavage fluid caused by the deposition of particles in the lower airways; various manifestations of systemic toxicity including always significant damage to the liver and kidneys; some cytological signs of a likely onset of hyperergic inflammation; moderate neurological disturbances associated with possible penetration of Me-NP into the brain from the blood as well as from the nasal mucous membrane along the olfactory pathway; a paradoxically low manifestation of pulmonary pathology due to low chronic retention of nanoparticles in the lungs; a genotoxic effect on the organism level.

As a protective measure, the toxicity and even genotoxicity of Me-NPs can be significantly attenuated by adequately composed combinations of some bioactive agents in innocuous doses.